

Total-Electron-Yield X-Ray Standing Wave Measurements of Multilayer X-Ray Mirrors

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We measured x-ray standing wave spectra of multilayer x-ray mirrors by monitoring the total-electron-yield (TEY) in BL-6.3.2 to obtain the information on their layer structure and interface roughness. This simple TEY x-ray standing wave measurements enable the simultaneous measurements of standing wave spectra and Bragg reflection spectra. Figure 1 shows the simultaneously measured Bragg reflection spectra and TEY spectra of Mo/SiC/Si multilayer mirrors [1], which have 7-Å-thick SiC layers between 26-Å Mo and 27-Å Si layers, measured by varying the incident angle from 30° to 90°. Standing wave structures were clearly observed around 97 eV and 92 eV in the TEY spectra (incident angle: 90°) of the annealed and as-deposited samples, respectively.

These standing wave structures shift to the higher energy region as the incident angles decrease from 90° to 70°, corresponding to the energy shift of the Bragg reflection. From the comparison in the reflectivity and the standing wave structures of the annealed multilayer with as-deposited one, it can be suggested that the interface structure is disarranged by the annealing. The TEY x-ray standing wave measurements have another advantage; x-y mapping of the standing wave signals can provide the spatial information of interface structure in the sample plane. Figure 2 shows the mapping spectrum of the standing wave peak signals on the as-deposited Mo/SiC/Si multilayer (4 mm x 4 mm) with the 90° incident angle. This spectrum shows that the layer structure in this 4 mm x 4 mm area is almost uniform. These results show that the TEY x-ray standing wave measurements are useful for the optical evaluation of multilayer x-ray mirrors, compensating the reflectivity measurements.

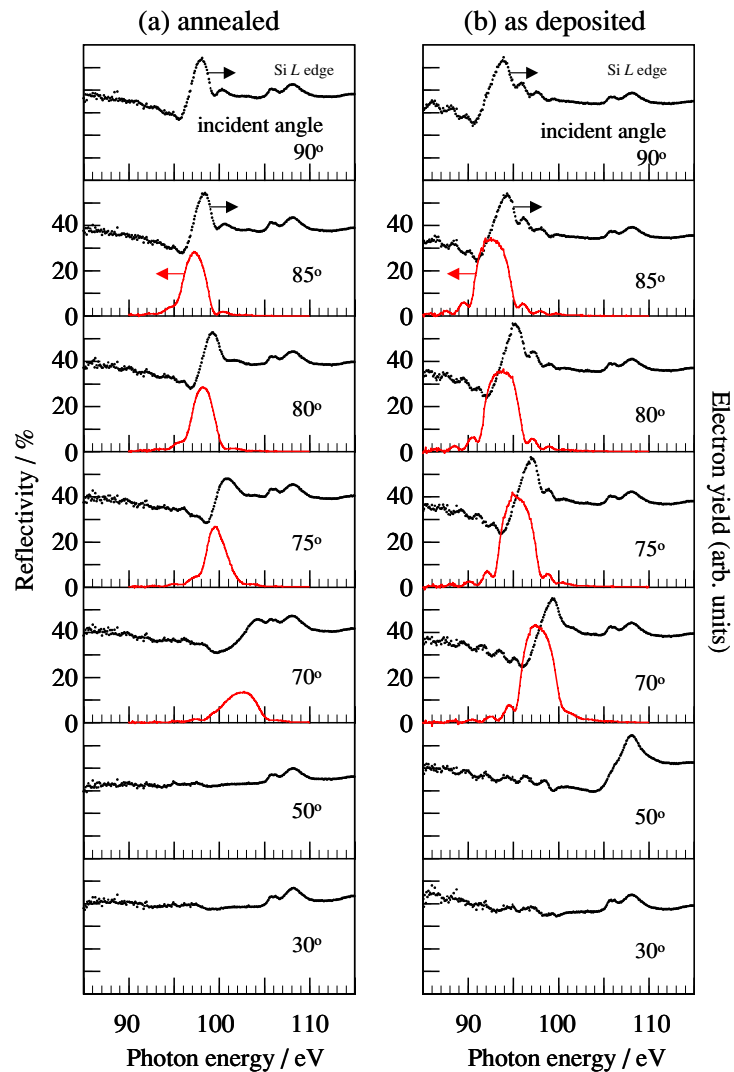


Figure 1. Bragg reflection and TEY x-ray standing wave spectra of (a) 600-°C annealed and (b) as-deposited Mo/SiC/Si multilayer mirrors.

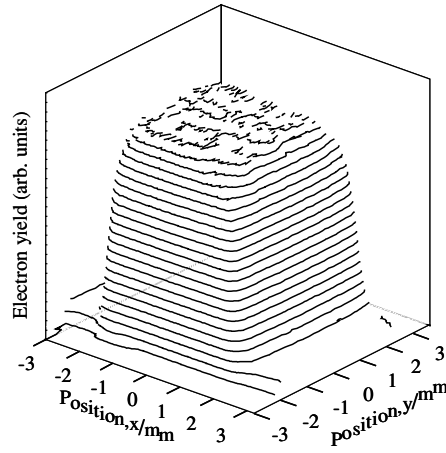


Figure 2. Mapping spectrum in the x-y plane of the standing wave signals on the as-deposited Mo/SiC/Si multilayer.

[1] Y. Muramatsu et al., Appl. Phys. Lett., 77, 2653 (2000).

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